ESA-044 Final Public Report

Introduction:
The ESA and training activities were provided through the United States Department of Energy-Energy Savings Now initiative, which was begun to help the largest natural gas users in the United States identify ways to reduce energy use. The steam system at the Foremost Farms USA facility in Richland Center, Wisconsin, was the target of the steam ESA conducted from April 12th to April 14th, 2006.

The total annual savings, considering the coincident impact of projects on each other was estimated at approximately $527,000 per year. Note that this value is less than the total of the savings provided in Table 1, because those values do NOT account for project interaction. The coincident totals account for the competing and/or complimentary effects of projects on one another, and are provided by the Steam System Assessment Tool (SSAT) assessment model included with this report as “ESA-044 10 Day Savings Spreadsheet (rev1).xls”

Steam System
Steam is provided to the facility using two of three available natural gas fired boilers. The rated boiler capacities are (2) 600 and (1) 900 boiler horsepower (BHP). Approximately 30-percent of the average boiler steam currently supplies a 4-effect pre-evaporator with thermal vapor recompression (TVR). A reverse osmosis system is installed on the front end of the pre-evaporator to increase the capacity of the whey concentration system. The performance of both the RO system and the evaporator indicate realistic opportunity for improvement.

Within the facility itself, there are a number of condensate collection centers that are vented to the atmosphere. These collection centers appear to provide an opportunity for flash steam recovery and recompression for process use, as long as the pressure is in the range of approximately 30-psig, or if the steam can be used to meet water heating demands. Because the potential exists at Richland Center as well as at other Foremost facilities based on group discussion, this opportunity was targeted.

Objective of ESA:
The primary objective of the ESA was to have the primary ESA lead, Larry Scott, become comfortable with using the DOE steam tools to evaluate steam system related energy cost reduction projects and to identify energy cost reduction projects for consideration. Particular attention was paid to the Steam System Assessment Tool (SSAT), which was used extensively. However, 3E Plus was also used to address several insulation related projects.

Focus of Assessment:
The focus of the assessment was on the reduction of steam system operating costs through walk-through assessments, review of boiler logs, combustion testing and the use of temperature metering equipment as appropriate. In addition to the normal facility assessment and software training activities, the ESA group was *very* engaged and asking many very good questions. As a result, a portion of time during the second day was spent considering the fundamentals of the various types of projects under consideration, including economizers and flash steam recovery.

Approach for ESA:
During the third day of the assessment, the Steam System Scoping Tool (SSST) was completed with input from Larry Scott, with the Richland Center facility scoring about 66%. Scores above 75% are considered very good. This indicates that the Richland Center facility is doing reasonably well in general steam system management practices, but that there are opportunities to improve. The areas where improvement can be made include steam system profiling, and steam system, end use and recovery operating practices. Addressing these will easily bring the score up but facility requirements will need to be considered to determine if a high score is truly economically practical. Note that the Visual Basic version of SSST was used. To access the SSST file, open SSST and select the file “Richland Center SSST.txt.” . See the “Results” tab of SSST, which was included with this report.

General Observations of Potential Opportunities:
The findings of the “Draft Final Report”, which are addressed in the sections below, review the identified best practice opportunities that were discussed during the ESA. Using natural gas at $9.00/MMBtu (conservative) the estimated annual energy cost savings is $527,000 per year if all projects listed in **Table 1** are implemented at one time. The largest single opportunity relates to improvement of the whey concentration system, with annual savings likely in the range of $370,000. In addressing the steam system boilers, an “impact” boiler efficiency of 83-percent was used. This is the weighted average efficiency of both operating boilers in use during the ESA.

Below are brief descriptions of each opportunity evaluated. In reviewing these descriptions, the following definitions will be helpful:

- Near term opportunities: Include actions that could be taken as improvements in operating practices, maintenance of equipment or relatively low cost actions or equipment purchases.

- Medium term opportunities: Require purchase of additional equipment and/or changes in the system such as addition of recuperative air preheaters and use of energy to substitute current practices of steam use etc. It would be necessary to carryout further engineering and return on investment analysis.
- Long term opportunities: Require testing of new technology and confirmation of performance of these technologies under the plant operating conditions with economic justification to meet the corporate investment criteria.

<u>1. Reduce Steam Demand-RO System improvement and optimization of multi-effect evaporator & TVR (Medium Term)</u>
The RO system is presently operating at a level below its concentration potential, given sufficient modifications. Additionally, the pre-evaporator thermal vapor recompressor is not efficient at present, but will need replacement anyway to allow optimal performance with the reduced water loading that will result from improvement of the RO system. As a result, the pre-evaporator steam demand can be reduced by an estimated 5,000 pph, while the RO system power consumption will increase to accommodate the higher level of concentration. Increases in RO power were estimated based on other work done by Tom Tucker. This project was discussed with Mr. Artur Zimmer to determine its validity. Mr. Zimmer believes this to be a project that will offer very good energy cost savings potential but that will not compromise reliability, productivity or quality. At an estimated cost between $250,000 and $350,000, the simple return is estimated to be in the range of one year.

<u>2. Reduce Steam Demand-Use steam jet pump for condensate flash recovery (Medium Term)</u>
Within the facility itself, there are a number of condensate collection centers that are vented to the atmosphere. These collection centers appear to provide an opportunity for flash steam recovery and recompression for process use. Since the condensate from the evaporator is beneficially used, the total motive steam load to the pre-evaporator and hi-con was deducted from the average steam output to obtain a balance of approximately 20,000 pph. It was then assumed that 30-percent of this could be diverted to an existing central collection area, and the flash steam collected and recompressed to meet lower pressure steam demands at 30-psig. Examples of process steam use at this pressure level are usually cooking, water heating loads, pasteurization heating and potentially others. Single nozzle Croll-Reynolds thermocompressors were priced based on 304 stainless steel, at approximately $7,000 each. At an estimated cost between $50,000 and $150,000, the simple return is estimated to be in the range of one to two years.

<u>3. Change Boiler Efficiency-Use feed water economizers (2 boilers, non-condensing; Medium Term)</u>
Non-condensing economizers are a time tested method of preheating boiler feed or other process water. Historically, non-condensing economizers have experienced cold end corrosion problems that have caused premature failure. The failure of the existing economizer that is presently disconnected may have been able to be avoided by more effective design and potentially, the use of different materials that would better resist corrosion.

Since there are two boilers normally in operation, adding a feed water economizer to each boiler exhaust stack will provide an estimated energy cost savings of $80,000 per year. Pricing was based on information provided by Cain Industries, a Wisconsin manufacturer of economizers.
At an estimated cost between $70,000 and $100,000, the simple return is estimated to be in the range of one to 1 ½ years for both boilers.

<u>4. Change Boiler Blow Down Rate (Short Term)</u>
The present boiler blow down rate was estimated at approximately 5.3-percent. The blow down is composed of a 15 second blow down once per day, an automatic blow down that is used on an as needed basis to provide water heating to an adjacent water tank, and a continuous skimmer.

The majority of the “blow down” appears to be related to water heating. The water heater is also backed up by a separate steam source, which means that the blow down rate can be reduced by allowing the separate steam source to provide the majority of the water heating. However, the heat presently lost to drain by continuous skimming should also be considered to provide water heating duty. The exact value of the skimming will need further consideration.

It was assumed that the blow down rate could be reduced to approximately 2-percent. This is equivalent to a boiler water conductivity of 6,000 micro-mohos. While an average blow down rate of 2-percent is generally attainable, the boiler water treatment system service provider should be consulted to be sure there are no other issues to consider.

At an estimated cost between $1,000 and $3,000, the simple return is estimated to be in the range of two years.

<u>5. Change Condensate Recovery Rate (Medium Term)</u>
While the facility appears to do a good job recovering condensate that is of sufficient quality, there does appear to be an opportunity to improve the recovery rate. To provide a suitable starting point, an additional 5-percent was assumed possible. This is based on discussion and observations during the facility walk-through.

Generally, condensate recovery may result from actual recovery of lost condensate by elimination of waste such as through vent steam or condensate loss reduction, or through live steam demand reduction. The estimated annual energy cost savings is approximately $10,000 at an implementation cost of $15,000 to $30,000, but this would need further consideration as the means to obtain the condensate reduction may vary considerably.

6. Improve Insulation (Short Term)
There were a number of areas in the facility that appear would benefit from improved insulation. This is particularly true of boiler feed water tank and supply piping, as well as some areas of the boiler surfaces. The savings in the boiler room alone was estimated in the range of $8,000 per year using 3E-Plus as an aide to evaluate the heat loss rates. However, the *total* cost savings modeled using SSAT was estimated at approximately $8,000 per year. The results from SSAT appear to be conservative, most likely due to the rules that SSAT uses. In any event, insulation improvement appears to be worthwhile and is recommended. At an estimated cost between $3,000 and $6,000, the simple return is estimated to be less than one year.

Management Support and Comments:
Generally, the initial feedback from the ESA group was favorable. A number of opportunities applicable to other facilities, all of whish have the potential to reduce gas use, were also discussed. While not relevant to the ESA at Richland Center, these specific opportunities by facility were:

- Plover facility
    - Improved boiler exhaust heat recovery
    - Improved utilization existing spray dryer exhaust heat recovery system through modification of the inlet header.

- Appleton facility
    - Flash steam recovery on the condensate collection system-70% of condensate passes through a single point.

DOE Contact at Plant/Company: (who DOE would contact for follow-up regarding progress in implementing ESA results…)

Plant Contact: Larry Scott
Company Contact: Wayne Gjersvig